

THE AFFECTED ENVIRONMENT

INTRODUCTION

This chapter provides a discussion, by resource, of the affected environment. Each section includes a description of the present and projected resource potential and Bureau of Land Management (BLM) management techniques. This information is summarized from the Management Situation Analysis document (MSA) on file at the BLM Billings Resource Area Office.

Portions of the U.S. Forest Service's wilderness area (Absaroka-Beartooth) in the Billings Resource Area are classified Class II. The Bighorn National Recreation Area in Big Horn County, also maintains a Class II rating. Yellowstone County is designated Class II.

The remainder of the Billings Resource Area (in Musselshell, Golden Valley, Wheatland, Sweet Grass, Stillwater and Carbon Counties) is designated Class II.

CLIMATE

The topographical conditions in the Billings Resource Area create a variable climate. Winters are generally cold with occasional mild or open years. Periods of cold weather may quickly be changed by warm chinook winds, followed by warmer weather. Moderate to strong winds occasionally cause blizzard conditions, primarily during the months of January, February and March. The average fall-winter temperature in the resource area is 36 degrees Fahrenheit (°F).

Summers are characterized by extreme temperature variations, low relative humidity, local thundershowers and an average temperature of 61°F. Most of the annual precipitation comes from high intensity summer showers. The average growing season varies from less than 100 days in the mountain areas, to more than 130 days in the valley bottoms. The average annual precipitation ranges from approximately 6 inches on the Pryor Mountain Wild Horse Range to more than 30 inches in the Beartooth uplands. The northern portions of the resource area average 11 to 13 inches of precipitation per year.

AIR QUALITY

The Federal Environmental Protection Agency (EPA) assigns air quality classifications with Class I being the best, and other classifications (Class II, Class III, etc.) indicating the increment of degradation from the desired air quality. Most of the Billings Resource Area is rated Class II.

GEOLOGY AND TOPOGRAPHY

The resource area lies within the Missouri Plateau subdivision of the Great Plains physiographic province. The terrain consists mainly of plains with isolated mountain ranges rising abruptly above the prairie (Perry, 1962).

Mountain ranges in the resource area include the Absaroka-Beartooth, Pryor, Big and Little Snowy, Bull and Crazy Mountains. Uplift of the rocks and resultant erosion have exposed the core of these ranges, providing evidence of their structures, and the forces which produced them.

The Absaroka-Beartooth Mountains dominate the southwest portion of the resource area. The range is composed mostly of Precambrian metamorphic rocks uplifted several thousand feet along faults. Overlying sedimentary rocks have been folded, and in several cases, tilted to a nearly vertical position, as seen in the limestone palisades south of Red Lodge, Montana.

The Pryor Mountains developed through generally vertical uplift along deep seated "basement" faults, fracturing the overlying strata into five distinct blocks, each with high-angle faults on their north and east flanks (Blackstone, 1975).

The Snowy and Little Belt Mountain Ranges are the most obvious expression of a general uplift which affected all of central Montana. This uplift was caused mainly by horizontal compression rather than the vertical forces previously described. The strata were folded into a series of anticlines (upfolds) and synclines (downfolds) (Reeves, 1931).

The Bull Mountains are a series of small, broken plateaus, little more than hills compared to the other mountains in the region. The massive sandstone and clinker beds which cap the plateaus are more resistant to erosion than the soft sandstones and shale which underlie them. The harder rocks are preserved as remnants of higher topographic relief, even though the geologic structure is a basin (Woolsey, et al., 1917).

The Crazy Mountains are unique. They were formed by the intrusion of molten rock (magma). The magma rose from great depth, and was injected into fissures between strata, doming the overlying sediments. Subsequent erosion exposed this igneous rock. A system of dikes (magma injected into cracks through the strata) radiate outward from the mountains like spokes from the hub of a wheel.

The surrounding plains areas are composed of flat-lying or tilted sedimentary rocks deposited during the Cretaceous Period and Paleocene Epoch. The rocks are mostly shales and sandstones with minor limestone, coal and bentonite beds. Folds and fault systems associated with mountain uplifts affect the bedding and outcrop pattern of these rocks (see Stratigraphic Column Chart, Figure 3.1).

Alluvium represents the most recent strata. It consists of fine to coarse grained sediments deposited by moving water and is found in active or abandoned stream channels, or as outwash benches on the foothills of mountains.

Energy Minerals

Southcentral Montana has had a rich oil and gas exploration history. The first oil well drilled in the state was in the Elk Basin Field in 1915. It extended previous exploration in northern Wyoming. The first "wildcat" well was drilled in Devils Basin in 1919 (Knapp, 1956).

Early oil and gas exploration was concentrated on areas with favorable surface geologic structures for the accumulation of oil. Thus, most early exploration occurred along the crests of anticlines, and near faults. As technology, especially seismic exploration, advanced, companies became able to identify promising structures or horizons which had no surface expression. Many of the more recent discoveries have relied upon seismic exploration for indications of where to drill.

There are 55 fields which have produced hydrocarbons (oil & gas) in the resource area. Most of the fields are structural, or structural/stratigraphic traps. Eleven fields have been abandoned. Table 3.1 gives the production figures and producing horizons for these fields (Montana Oil and Gas Commission, 1981).

Coal may be found at several stratigraphic horizons, including the Cretaceous Eagle, Judith River, Hell Creek and the Paleocene Fort Union formations. Table 3.2 is an analysis of coal samples from the fields described below.

The Eagle formation outcrops (comes to the surface) over a large area, forming rimrocks along the Yellowstone and Clarks Fork River valleys. Coal is found in the middle (shale) member of the Eagle. Valuable coal occurs

in an area bounded on the north by Rock Creek, and on the south and east by the Clarks Fork (see Figure 3.2). Shale or bone partings separate the coal into as many as three distinct beds. These partings may have affected the way coal was mined and its overall quality.

A major fault offsets the Eagle outcrop, effectively dividing coal development into two fields (see Figure 3.2). Underground mines were opened in this area in the late 1800's. Most development occurred at the mine west of Bridger, where the coal was thickest, though several smaller mines were opened west of Fromberg. The mines shut down in the 1930's. No total production figures are available, though over 100,000 tons were produced in 1907.

The coal resources for the Bridger Field can only be estimated. There has been no recent exploration, and the only records are from mines abandoned nearly 50 years ago. The coal field covers 13,660 acres, of which 9,240 acres are Federally owned. If the measured thickness of 4 feet of coal is consistent throughout the field, the total coal resource is about 95 million tons (64 million tons Federal). Due to the numerous thin partings, no more than 50% of the coal, 32 million tons, would be recoverable through normal underground mining methods.

HKH Associates has filed a letter of interest in Federal coal in the Joliet/Fromberg Field. The group has obtained leases on private coal near the outcrop, and on surface lease options from some surface owners overlying Federal coal. Federal ownership forms a nearly solid block of coal 3 to 4 miles wide, and 1/2 mile inside the outcrop.

The BLM has identified Federal coal having development potential through either surface or underground mining (Berg, 1982). The area of strippable coal totals 1,360 acres, of which 320 acres are Federal. Coal resources within that area were estimated at 12.7 million tons (2.32 million tons Federally owned). At 90% recovery, over 2 million tons of Federal coal are considered strippable.

The area of underground minable coal is much larger. Approximately 8,680 acres of Federally owned coal underlies approximately 5,480 acres of this. Overall, 68.7 million tons of coal resources have been identified (45.8 million tons Federal coal). If it is assumed that underground mining would be by room and pillar method, 50% of the coal, or 34.4 million tons (23.3 million tons Federal coal) would be recoverable.

The Silvertip and Stillwater fields (see Figures 3.3 and 3.4) contain coal from the shale member of the Eagle formation. The coal is fairly uniform, averaging a thickness of about 4 feet in two or three beds separated by shale partings. Little coal was produced from either field, though many prospects were noted on older topographic maps, and some may still be visible on the ground. The only potential for renewed development of fields would be small quantities for local domestic use, which is unlikely. Coal development in the Silvertip Field may conflict with production from the Elk Basin Oil Field, which occupies a similar area.

FIGURE 3.1 STRATIGRAPHIC COLUMN IN THE BILLINGS RESOURCE AREA.

STRATIGRAPHIC COLUMN								
FORMATION		Range of Avg Thickness	DESCRIPTION	FORMATION		Range of Avg Thickness	DESCRIPTION	
CENEZOIC	QUATERNARY	Alluvium	Unconsolidated stream and fan deposits range from fine to coarse grained.	TRIASSIC	Chugwater	0-800'	Brick-red sandstones, shales and siltstones, often ripple-marked; gypsum bed 20-30' thick.	
		TERTIARY	Tongue River Member		Fort Union Formation	Embar	5-100'	White porous limestone. Reported gypsum bed; oil producer in Elk Basin field.
			Lebo			Ten Sleep	50-105'	White to buff cross-bedded soft sandstone; oil producer in Elk Basin field.
			tullock			Amsden	150-350'	Red shales, white limestone, chert/limestone breccia; uranium mineralization; contains oil in Central Montana fields.
	Hellcreek	300-1200'	Fresh water deposits of alternating sandstones and clay shales.	PENNSYLVANIAN	Alaska Bench	100-150'	Hard gray fossiliferous limestone; exposed in Snowy Mountains.	
	Fox Hills Sandstone	100-200'	Gray to yellowish sandstone and sandy shales.		Tyler	5-100'	White to brick-red cross-bedded channel sandstone; produces oil in Central Montana fields.	
	Bear Paw	900'	Steel-gray to black marine shale containing a few grayish white and dark-red concretions and beds of bentonite.		MISSISSIPPIAN	Heath	150-500'	Found in Central and Eastern Montana only. Heath: Black shales and black limestones; serves as source rock for petroleum in Central Montana oil/metalliferous shale.
	Judith River	200-400'	Fresh and brackish water deposits consisting of irregularly and thin-bedded gray clayey sand sandstone, lignite clay and coal beds.	Otter			Otter: Light green shales and limestone.	
	Claggett	500'	Dark-brownish-black marine shale containing persistent yellow calcareous concretionary beds; bentonite and tan sandstone in the upper part.	Kibbey			Kibbey: Red to brown sandstones and shale; some gypsum.	
	Eagle	220'	Massive and thin-bedded buff to white sandstone, carbonaceous shale and coal beds.	Mission Canyon		600-1200'	Mission Canyon: Massive white or gray (marine) limestone.	
Telegraph Creek	180-300'	Dark gray-black, thin beds of marine shale with thin sandstone members especially near the base; fossiliferous; gypsiferous.	Lodgepole			Lodgepole: Thin bedded, cherty, fossiliferous limestone; produces oil in Elk Basin field.		
Niobara	200'	Upper part marl, lower lightish yellow to whitish limestone.	DEVONIAN	Three Forks		200-250'	Multicolored shales with thin dark limestone and yellow sandstone.	
Carlisle	150-300'	Gray shales with thin shaly to silty sandstone layers, some bentonite, some ironstone concretions.		Jefferson		50-600'	Brown to gray and black limestone and dolomite.	
Greenhorn	600'	Black shales with hard, thin sandstone beds, buff-light gray limestone layers in eastern Montana with interbedded calcareous shales, some bentonite.	ORDOVICIAN	Big Horn Dolomite		250-300'	Thin bedded or massive limestones and dolomites; upper portion very fossiliferous.	
Frontier	150-500'	Alternating beds of gray to yellow sandstone and dark carbonaceous shales; contains bentonite beds in Carbon County. Produces gas in Dry Creek field.		CAMBRIAN		Gros Ventre	700'	Greenish and gray calcareous shales and oolitic limestones.
Mowry	180-325'	Hard light gray shales and thin-bedded sandstone; contains numerous fish scales; also bentonite mined in Carbon County.	Flathead			185'	Hard dense quartzite with red to brown sandstone.	
MESOZOIC	CRETACEOUS	Thermopolis	700-760'	Upper and lower members are thick dark marine shales; middle member yellow-brown sandstone; shales have bentonite beds mined in Carbon County.	PALEOZOIC	PRECAMBRIAN	Pre Cambrian	Gneisses and schists, exposed only near Dryhead area of East Pryor Mountain, and on top of Beartooth Mountains.
		Cloverly	160-500'	Upper member - Greybull sandstone; middle multicolored shale member; lower, Pryor conglomerate contains vertebrate fossils and petrified wood. Some uranium mineralization; gas producer in Dry Creek field.				
		Kootenai						
		Morrison	150-200'	Interbedded buff sandstone and gray-green shales; vertebrate fossils; some uranium mineralization.				
		Swift	10-300'	Green shales and fine-grained thin bedded brown or green sandstone; fossiliferous (marine).				
JURASSIC	Riardon	50-250'	Gray to green marine shales and thin limestone; fossiliferous.					
	Piper	0-150'	Red to green shales and limestone with some gypsum.					

TABLE 3.1: OIL PRODUCTION

Oil Fields	Cumulative	Production (Barrels)											
		1980	1979	1978	1977	1976	1975	1974	1973	1972	1971	1970	1969
Big Gully	82,575	4,593	6,518	11,981	39,368	20,115							
Big Gully, North	12,755	2,915	3,701	6,139									
Big Wall	7,008,909	104,447	112,785	90,003	64,962	64,562	69,860	62,117	62,266	75,468	99,403	131,845	172,717
Big Wall, North	6,948	575	982	2,762									
Clark's Fork	83,368	467	843	157		545	787						
Clark's Fork, North	1,023,765	1,505	1,554	897	1,066	1,381	2,423						
Clark's Fork, South	80,230	2,236	1,651	2,707	3,086	4,827	11,842			4,230	18,382		
Dean Dome	26,719	3,146	5,367	7,137	7,620	2,962							
Delphia	303,094	2,123	2,186	3,472	1,683	4,676	7						
Devil's Basin	63,462	3,583		1,406	796	1,951	2,040						
Dry Creek	4,076,740	10,454	15,019	23,985	42,698	17,815							
Dry Creek, West	4,888	1,639	3,068	181									
Elk Basin	76,531,786	917,797	987,401	941,075	1,023,146	1,071,748	1,190,265	845,581	1,386,509	1,582,651	1,790,439	2,061,378	2,440,434
Elk Basin, Northwest	1,188,945	12,219	11,206	13,103	21,105	39,137	31,744	26,991	36,021	45,182	79,540	139,973	141,791
Fiddler Creek	153	153											
Frannie	721,869	3,654	5,905	8,678	8,406	8,258	8,170	7,784	11,558	18,304	26,901		
Gage	564,321	1,988	772	998	1,286	1,576	1,377						
Golden Dome	40,757	252		1,807	2,193								
Hiawatha	1,348,894	30,627	36,218	47,842	53,607	49,161	52,604	62,797	64,154	77,858	88,603	113,639	189,990
Howard Coulee	99,304	4,002	13,051	22,992	24,753	8,093	5,370	21,043					
Ivanhoe	4,422,375	13,779	20,200	30,941	27,316	30,015	32,829	31,259	38,171	48,881	53,401	87,493	94,172
Jim Coulee	3,480,263	143,639	205,571	258,529	312,981	489,808	500,029	463,170	476,508	529,071	80,789		
Keg Coulee	4,872,296	64,366	94,798	85,079	96,732	142,135	110,637	140,120	262,297	179,839	149,692	164,186	124,893
Keg Coulee, North	357,123	19,080	18,715	23,248	14,944	19,591	23,349	24,262	35,622			9,122	11,183
Kelley	880,092	13,359	13,799	18,542	25,357	35,000	44,237	46,293	62,524	85,876	53,414	49,798	100,269
Laurel	825	391	434										
Little Wall Creek	1,940,980	213,932	196,183	223,990	196,103	319,342	384,259	297,316	39,646	37,053	46,313	6,887	
MacKay Dome	10,721	4,993											
Mason Lake	504,325	139,967	175,886	23,587	3,114	4,475	5,705					10,178	12,672
Mason Lake, North	10,047	1,803	1,663	1,180									
Melstone	2,248,862	152,349	138,068	131,392	121,995	17,228	17,256	19,065	22,872	23,077	21,205	21,593	27,144
Mosser	292,032	5,893	5,949	5,441	5,974	6,145	4,679						
Ragged Point	3,150,125	52,696	52,462	53,392	96,784	136,932	238,019	145,936	154,670	61,175	68,801	77,267	83,556
Roscoe Dome	2,319	635	1,684										
Sheepherder	59,480	2,771	3,464	4,404	7,290	11,139	25,502						
Stensvad	10,020,655	6,662	4,399	12,053	71,793	53,722	108,185	257,508	543,468	304,233	427,078	242,006	163,661
Tippy Butte	11,845	7,025		4,820									
Wagon Box	21,024	944	714	891	1,382	2,318	4,304						
Weed Creek	581,395	4,724	4,281	5,629	14,774	13,381			5,513	16,976	29,656	48,437	89,486
Willow Creek, North	271,294	9,146	7,559	8,013	10,369	14,646	11,398	14,406	34,398	25,699	58,839		
Winnett Junction	500,796	77,678	84,029	108,090	39,989	36,191	48,338	76,274	32,007				
Wolf Springs	4,566,948	15,420	25,730	19,951	12,046	13,574	15,414	16,896	18,960	29,893	53,138	40,744	62,776
Abandoned Fields													
Belfry	91,804												
Gage, Southwest	16,289												
Lake Basin	473,639												
Musselshell	14,938												
Pole Creek	169,726												
Womens Pocket	3,526												
Yellowstone	39,405												
Wildcats													
Carbon	6,399												
Musselshell	925												
Stillwater	11,283												

Table 3.1 (cont.)

OIL AND GAS PRODUCING HORIZONS

Field	Hydrocarbon	Formation	Age
Belfry	(oil)	Tensleep	(Penn.)
Big Coulee	(gas)	3rd Cat Creek	(L. Cret.)
	(gas)	Morrison	(U. Jur.)
Big Gully	(oil)	L. Tyler	(Penn.)
Big Gully, North	(oil)	L. Tyler	(Penn.)
Big Wall	(oil)	Amsden	(Penn.)
	(oil)	Tyler	(Penn.)
Big Wall, North	(oil)	Stensvad	(Penn.)
Clarks Fork	(oil)	Frontier	(U. Cret.)
Clarks Fork, North	(gas and oil)	Dakota	(L. Cret.)
Clarks Fork, South	(oil and gas)	Greybull	(L. Cret.)
Dean Dome	oil and gas	Greybull	(L. Cret.)
Delphia	(oil)	Amsden	(Penn.)
Devil's Basin	(oil)	Heath	(U. Miss.)
Dry Creek	(gas)	Judith River	(U. Cret.)
	(gas)	Eagle	(U. Cret.)
	(gas)	Frontier	(U. Cret.)
	gas	Greybull	(L. Cret.)
	(oil)	Greybull	(L. Cret.)
Dry Creek, Middle	(gas)	Frontier	(U. Cret.)
	(gas)	Dakota	(L. Cret.)
Dry Creek, West	(oil and gas)	Greybull	(L. Cret.)
Dry Creek, shallow gas	(gas)	Judith River	(U. Cret.)
	(gas)	Eagle	(U. Cret.)
	(gas)	Virgelle	(U. Cret.)
Elk Basin (Montana part)	oil	Frontier	(U. Cret.)
	oil	Embar-Tensleep	(Penn-Penn)
	oil	Madison	(Miss.)
	oil	Big Horn	(Orl.)
Elk Basin, Northwest	oil	Frontier	(U. Cret.)
	oil and gas	Embar-Tensleep	(Penn-Penn)
	oil	Madison	(Miss.)
Fiddler Creek	oil	Greybull	(L. Cret.)
Frannie (Montana part)	oil	Tensleep	(Penn.)
Gage	(oil)	Amsden	(Penn.)
Golden Dome	(gas)	Eagle	U. Cret.
	(oil)	Greybull	L. Cret.
Hiawatha	(oil)	Tyler	(L. Penn.)
Howard Coulee	(oil)	Tyler	(L. Penn.)
Ivenhoe Dome	oil	Morrison	(U. Jur.)
	oil	Amsden	(L. Penn.)
	oil	Tyler	(L. Penn.)
Jim Coulee	oil	Tyler	(L. Penn.)
Keg Coulee	(oil)	Tyler	(Penn.)
Kelley	(oil)	Tyler	(Penn.)
Lake Basin	(gas)	Eagle	(U. Cret.)
	(gas)	Telegraph	(U. Cret.)
Lake Basin, North	gas	Judith River	(U. Cret.)
	gas	Claggett	(U. Cret.)
	gas	Virgelle	(U. Cret.)
	gas	Eagle-Frontier	(U. Cret.)
Laurel	(oil)	Dakota	(L. Cret.)
Little Wall Creek	(oil)	Tyler	(Penn.)
MacKay Dome	(oil)	Greybull	(L. Cret.)
Mason Lake	(oil)	Dakota	(L. Cret.)
Mason Lake, North	(oil)	Amsden	(Penn.)
Melstone	(oil)	Tyler	(Penn.)
Mosser Dome	(oil)	Greybull	(L. Cret.)
Ragged Point	(oil)	Tyler	(Penn.)
Rapelje	(gas)	Judith River	(U. Cret.)
	(gas)	Claggett	(U. Cret.)
	(gas)	Eagle	(U. Cret.)
	(gas)	Virgelle	(U. Cret.)

Table 3.1 (cont.)

OIL AND GAS PRODUCING HORIZONS (cont.)

Field	Hydrocarbon	Formation	Age
Roscoe Dome	(oil)	Dakota	(L. Cret.)
Sheepherder	(oil)	Tyler	(L. Penn.)
Stensvad	(oil)	Tyler	(Penn.)
Tippy Buttes	(oil)	Tyler	(Penn.)
Wagon Box	(oil)	Tyler	(Penn.)
Weed Creek	(oil)	Amsden	(Penn.)
Willow Creek, North	(oil)	Tyler	(Penn.)
Winnett Junction	(oil)	Tyler	(Penn.)
Wolf Springs	(oil)	Amsden	(Penn.)

PRODUCTION, MCF

Gas Fields	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	TOTAL
Big Coulee	1,038,834	997,198	1,110,189	1,215,817	1,126,326	1,070,160	1,510,941	1,486,330	1,397,243	1,388,246	1,235,579	857,667	14,434,530
Clarks Fork, North							41,286	22,908	7,953	603		630	73,380
Clarks Fork, South	84,192						5,884	34,604	41,711	77,322	106,781	35,098	302,000
Dry Creek	450,222	470,661	427,736	412,539	461,849	406,856	696,958	728,593	765,124	1,089,148	1,117,789	1,084,288	8,441,813
Dry Creek, Middle							4,657	40,732	35,390	25,978	26,002	28,796	161,555
Elk Basin	945,218	1,190,053	813,162	476,402	463,018	801,687	372,823	369,600	216,535	75,104	90,270	58,612	5,672,484
Lake Basin	1,220,808	884,765	820,416	544,026	119,933	983,843	1,115,082	649,048	355,940	265,594	429,260	593,560	9,229,817
Rapelje						78,363	704,373	490,646	332,266	189,490	173,277	140,748	7,982,275

Source: Montana Oil and Gas Commission, 1970-1981

TABLE 3.2: ANALYSES OF COAL SAMPLES

Coal Field	Values							
	As Received				Air Dried			
	Btu/lb	% Fixed Carbon	% Ash	% Sulfur	Btu/lb	% Fixed Carbon	% Ash	% Sulfur
Bear Creek	11,194	46.71	6.02	1.44	11,422	47.67	6.14	1.47
Bridger	10,037	44.89	13.35	0.33	11,005	49.22	14.64	0.36
Joliet-Fromberg	10,235	46.16	16.42	0.63	10,629	47.94	17.05	0.65
Mammoth-Rehder	10,120	45.10	6.34	0.49	10,430	46.50	6.54	0.50
McCleary	9,270	46.30	6.50	0.43	10,250	51.10	7.20	0.47
Silvertip	?	?	?	?	?	?	?	?
Stillwater	10,680	44.50	16.41	0.53	10,940	45.60	16.81	0.54

Sources:

1. Woodruff, E.G. 1907. The Red Lodge Coal Field, USGS Bull. 341a, p. 105
2. Washburne, C.W. 1907. Coal fields of the northeast side of the Bighorn Basin, Wyoming, and of Bridger, Montana, USGS Bull. 341c, p. 198
3. Woolsey, et al. 1947. The Bull Mountain Coal Field, USGS Bull. 647, p. 51,53
4. Calvert, W.R. 1916. Geology of the Upper Stillwater Basin, Stillwater and Carbon Counties, Montana with special reference to coal and oil, USGS Bull. 641, p. 210

Figure 3.2 . Joliet Fromberg/Bridger Coal Map

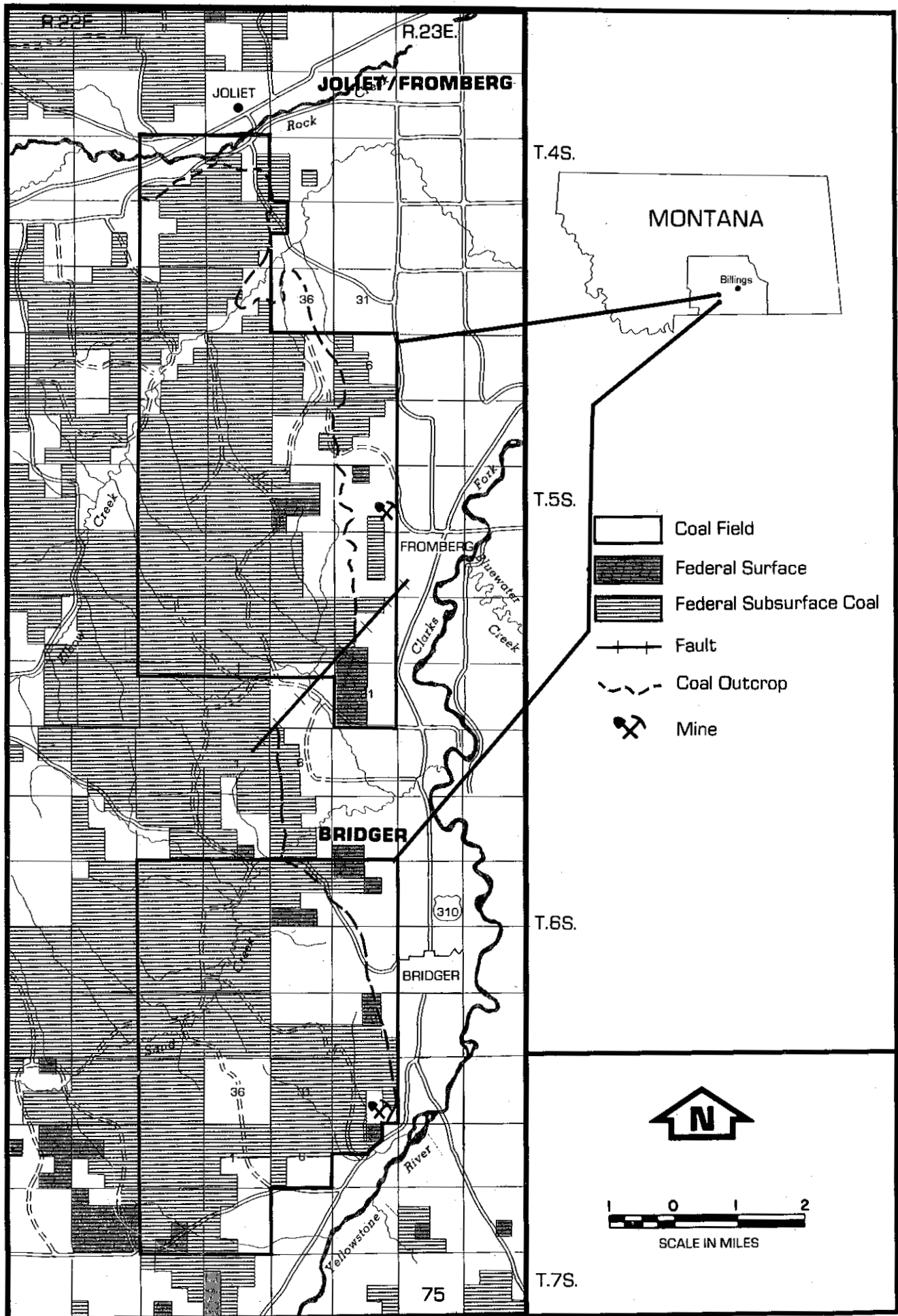


Figure 3.3. McCleary Coal Bed and Silvertip Coal Field Map

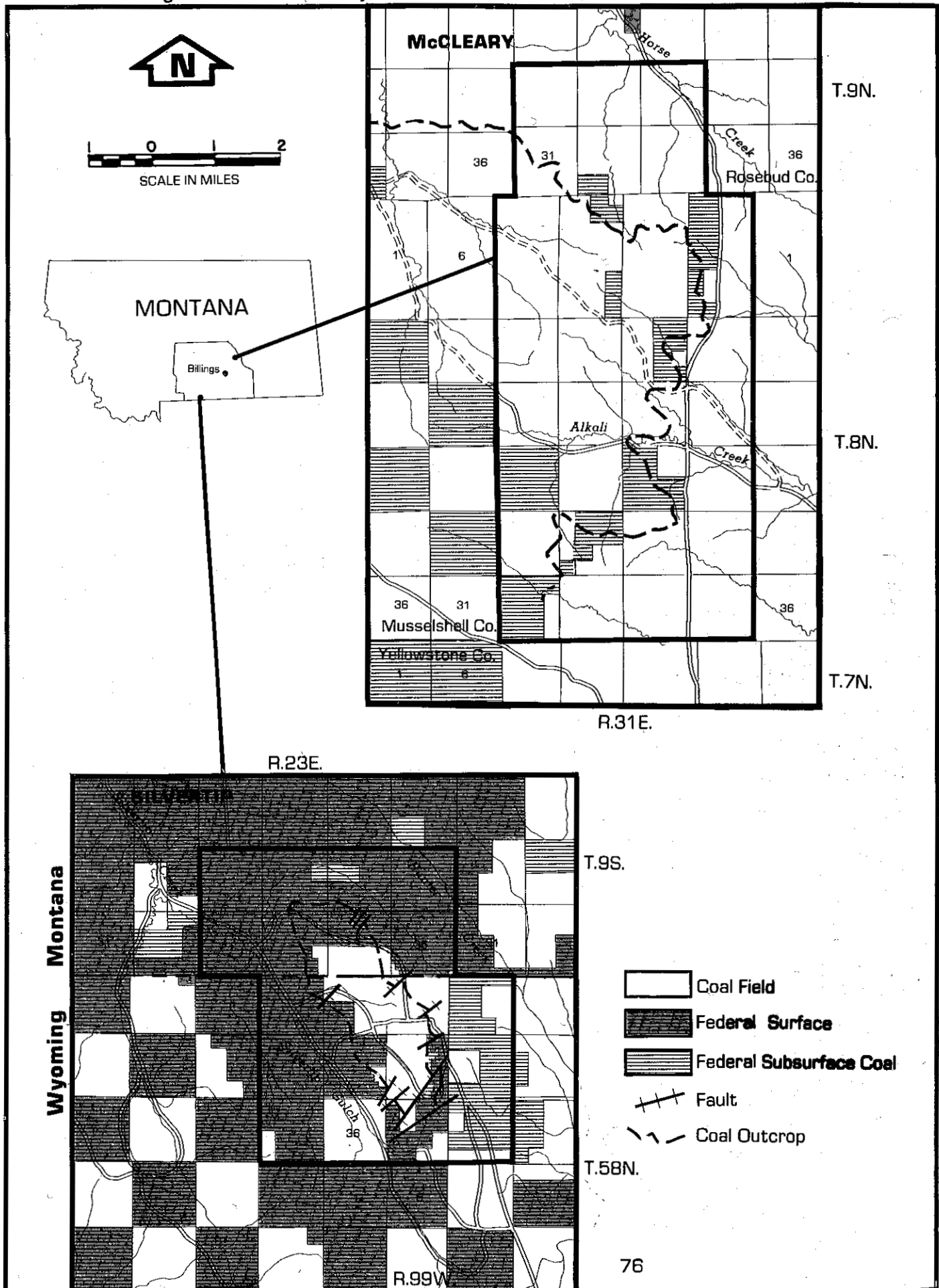
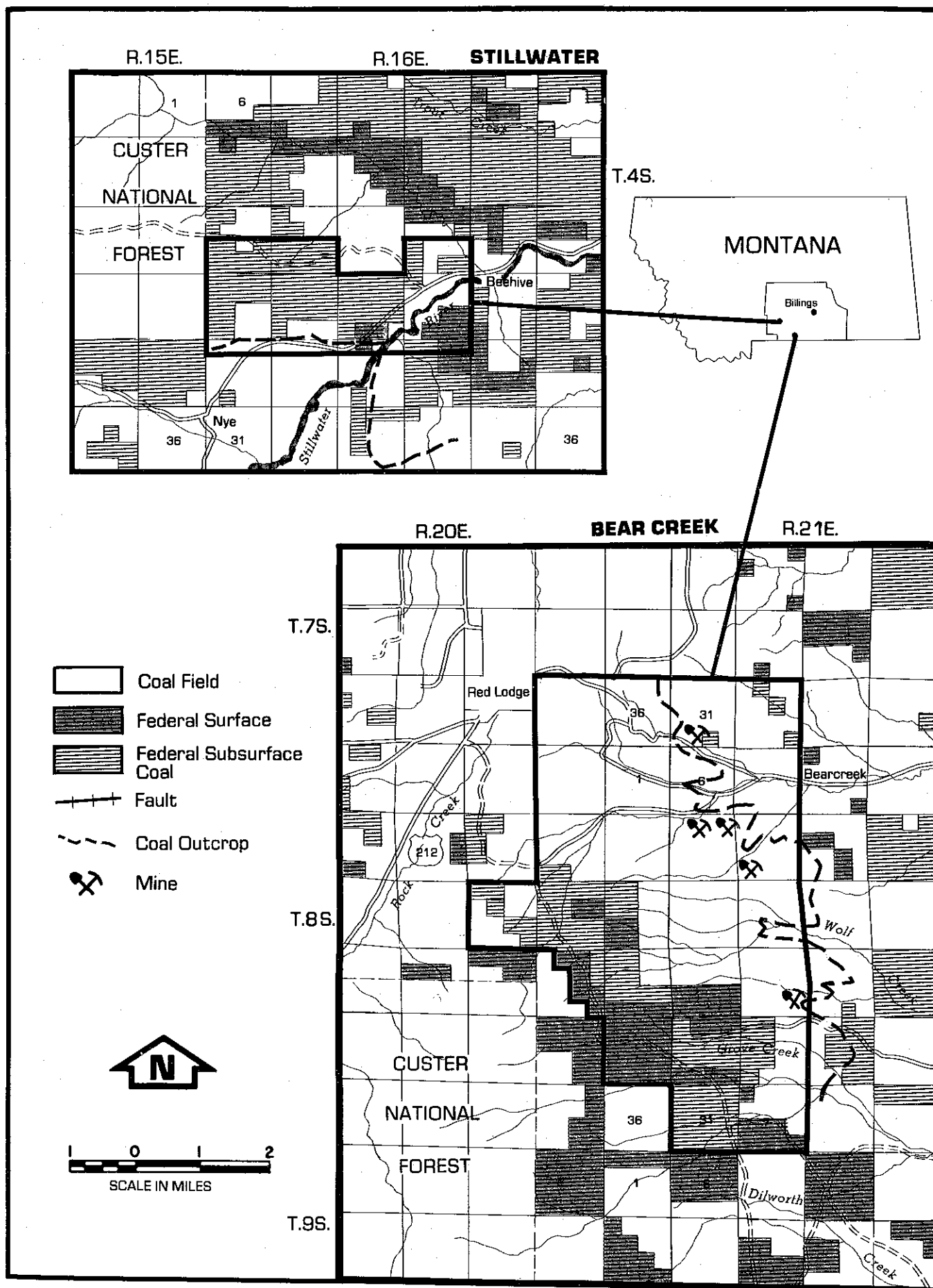


Figure 3.4 . Stillwater and Bearcreek Coal Fields



Federal ownership of coal is scattered in the Stillwater Field. The coal outcrop in the Silvertip Field is almost entirely in Federal ownership. No accurate estimate of the recoverable coal resources within these fields may be made at this time.

The Judith River and Hell Creek formations contain coal which is generally thin (less than 2 feet thick) and often has a high content of volcanic ash, lowering its quality. These formations outcrop in western Musselshell and Yellowstone Counties and northern Carbon County. Little of this coal is in Federal ownership. Development potential is considered low.

The Bull Mountain Field contains coal from the Tongue River member of the Fort Union formation (see Figure 3.5). Twenty-six coal beds have been mapped and named. The geologic structure of the field is a shallow basin, with the north flank having a steeper pitch. Coal beds outcrop in the form of a ragged bullseye, with younger beds exposed more toward the center. Most of these coals are important only in portions of the field, since they thin or pinch out completely elsewhere.

The most important coal to date has been the Roundup bed. Most of the 39.8 million tons produced from this bed, have been from underground mines near Roundup, and Klein, Montana. This coal may be mined out, with no further production potential.

The two coal beds creating the most interest at this time are the McCleary and Mammoth-Rehder. The McCleary bed lies relatively low in the Tongue River member. It is distinguishable throughout the field, but is only important in the northeastern portion (south of Melstone) where it may reach 8 feet in thickness. The Keanie underground mine produced coal from the McCleary in the early 1900's, but it has since closed. The U.S. Minerals Management Service (now part of BLM) has indicated areas where Federal coal has high to moderate potential for development either through surface or underground mining methods (McKay, 1982). The area of strippable coal totals 5,640 acres, of which 1,280 acres are Federally owned. Coal resources within that area were estimated to be 42.6 million tons (8.9 million tons Federal). At 90% recovery, over 8 million tons of Federal coal in the McCleary bed is considered strippable. The area of underground minable coal covers 3,120 acres, containing 25.5 million tons of coal. The Federal ownership in this area is 400 acres, with 1.78 million tons. Assuming the coal would be mined by room and pillar method, 50% or 0.89 million tons would be recoverable. Should long wall mining be used, the potential coal recovery rate should be higher.

The Mammoth-Rehder coal bed lies near the middle of the Tongue River member. It consists of an underlying Mammoth coal bed (averaging 9 feet thick) separated from the overlying Rehder tongue (2 to 5 feet thick) by a parting which varies from 0 in the southeast to 35 feet in the western part of the field (producing one 13' thick coal bed). This coal bed is the thickest and most consistent in the field. Though the coal is often burned at outcrop, the burning did not progress far underground.

This coal bed may be developed through both surface and underground mines. The basal structure of the Bull Mountains limits surface mining to a 1/4 to 3/4-mile wide strip along the outcrop of the coal seam (see Figure 3.5). Within this area (58,040 acres), about 604 million tons (308 million tons Federal) of coal resources may be found, of which probably 90% are recoverable.

Almost the entire coal bed may be developed through underground mining methods. The BLM has identified over 590 million tons of coal underlying over 32,500 acres. Federal ownership is 255 million tons underlying 14,000 acres. Depending upon the mining method, 50-60% of this coal may be recoverable. (See coal section of the MSA.)

Given the relatively high coal quality, surprisingly little development has occurred, though the coal was heavily prospected in the period 1910-1920. It's probable that these coal beds were too inaccessible to develop at that time.

At the present time two small surface mines are in operation, each producing about 10,000 tons of coal per year. The coal supplies the regional domestic market. The PM Mine has produced Burlington Northern-owned coal for many years. The Divide Coal Company had operated an underground mine for many years on privately-owned coal. In 1962, the company was issued a Federal lease (M-052647) and began mining Federal coal. The mine was converted from an underground mine to a surface operation in 1972 (the company felt it could not economically comply with the Federal Coal Mine Health and Safety Act of 1969). The Divide Coal Company is stripping in the direction of the abandoned underground mine. Unless the lease acreage is increased the company will exhaust the reserves within the leasehold in less than 4 years.

Consolidation Coal Company opened a test pit in the northwestern part of the field in 1971. To determine its suitability for generating electricity approximately 50,000 tons of coal were mined. The company also wanted to test several reclamation techniques. Though the coal proved suitable for use in coal-fired utilities, no further development followed.

Thickness, quality and depth-to-coal information has since been obtained on the checkerboarded Burlington Northern coal. From this data (Conner, 1980;1981), a preliminary high to moderate stripping potential map was prepared, using a cutoff ratio (overburden to coal) of 20:1 (see Figure 3.5). It is understood that using this ratio results in coal tonnage figures which may not all be minable. It does, however, permit further study of all acreage underlain by coal having some potential for development. Coal with overburden thicker than this would not likely be developable unless by underground mining methods. The Federal coal ownership is checkerboarded, covering almost 44% of the coal in the field. Figure 3.6 shows the area of surface mineable coal based on a 10:1 stripping ratio. The coal is currently of high development potential. However, the 20:1 ratio will be used in determining high and moderate development potential coal.

Figure 3.5 Mammoth-Rehder Coal Bed (20:1 ratio)

MAMMOTH-REHDER

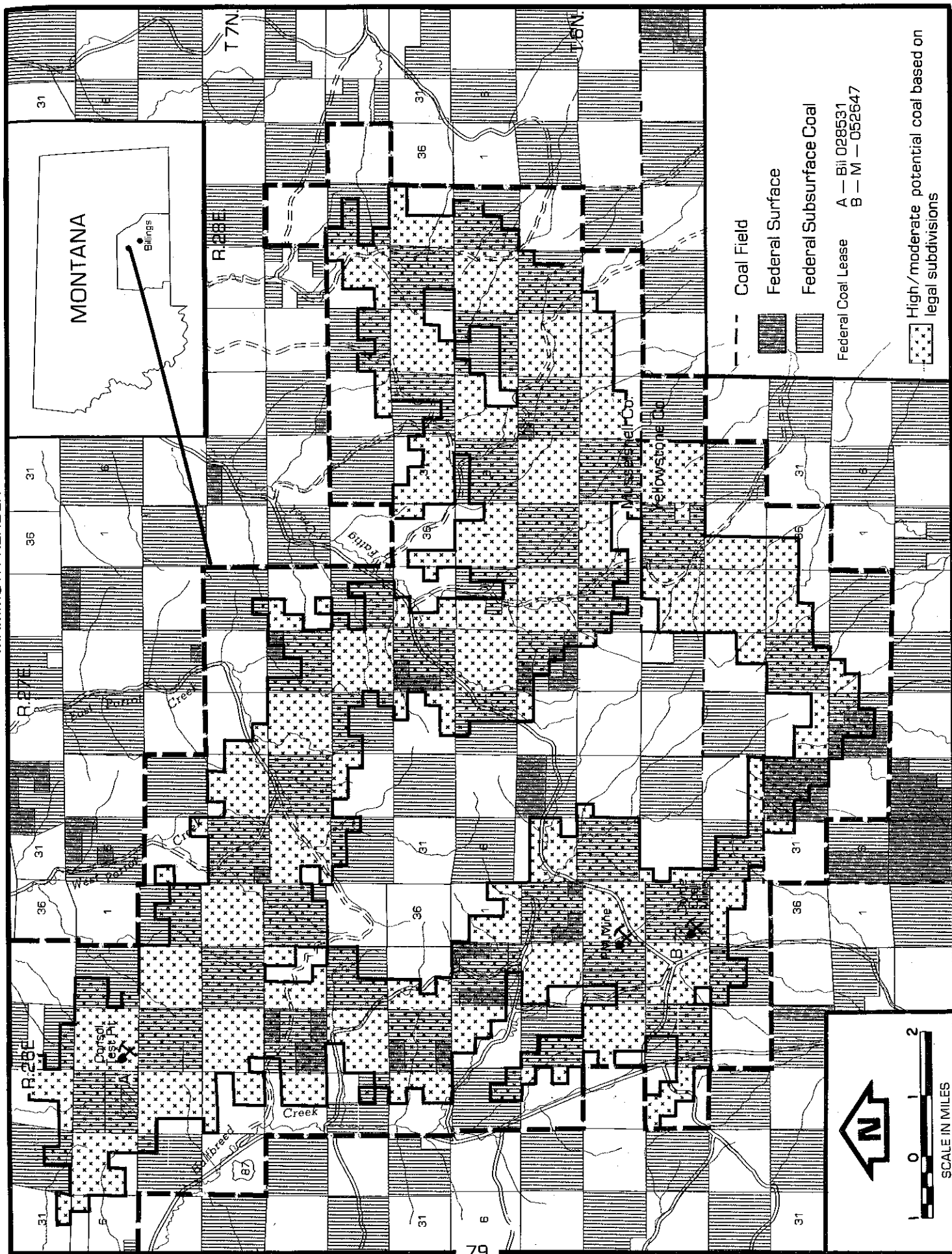
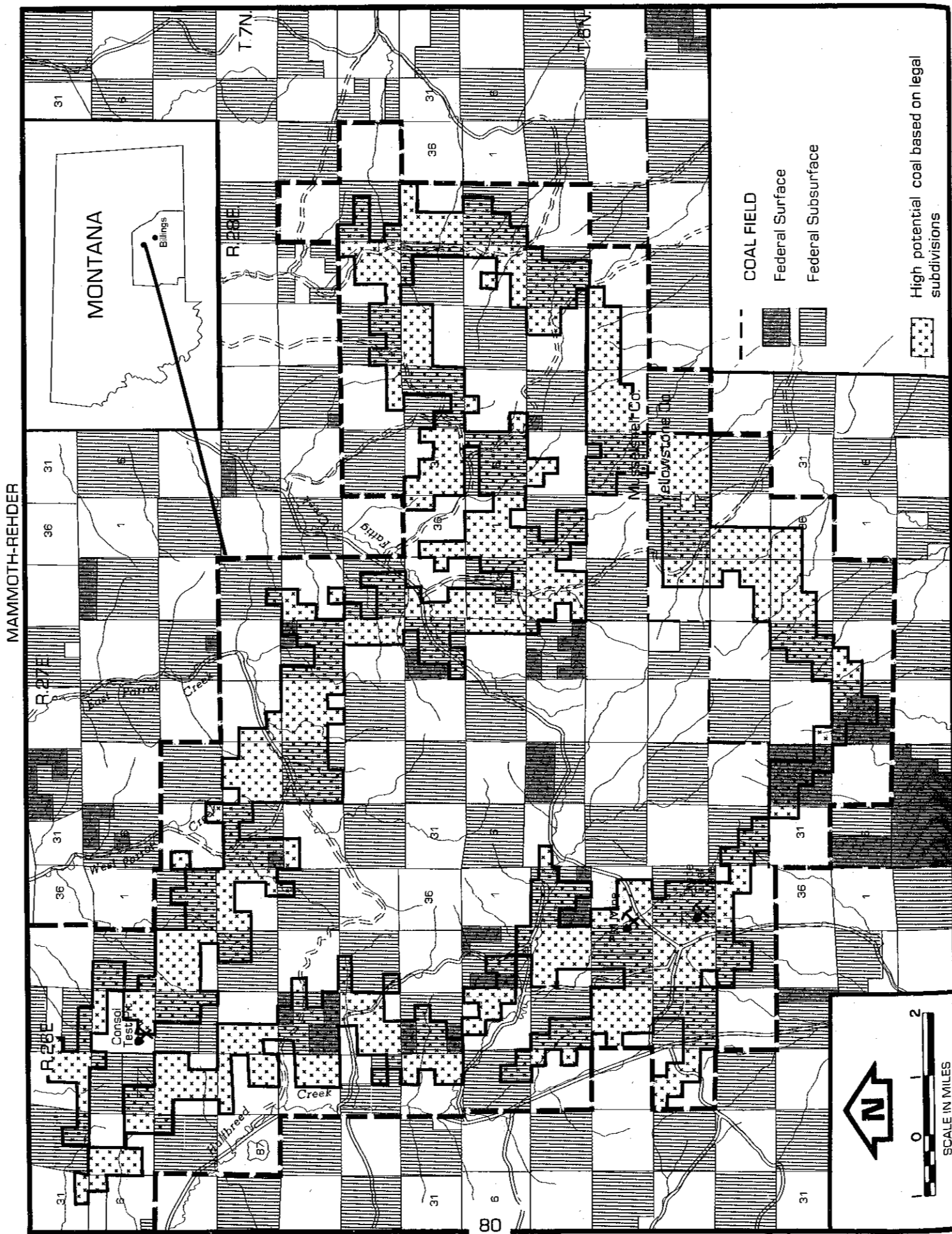


Figure 3.6: Mammoth-Rehder Coal Bed (10:1 ratio)



Meridan Lands and Minerals Company (a wholly owned subsidiary of Burlington Northern) has expressed interest in exchanging Federal coal rights for Burlington Northern coal rights in order to create two blocks of coal which may be mined independently. No formal proposal has yet been made and no specific areas identified.

Louisiana Land and Exploration Company continued coal inventories and began undertaking environmental and economic feasibility studies in 1979, with the hope of obtaining a permit to underground mine BN coal. The company withdrew its application in late 1981 after determining that new development was economically unfeasible under the current conditions.

A stumbling block to coal mining in this area is the lack of rail service. The Burlington Northern Railway recently purchased the Milwaukee Road right-of-way between Slayton and Gage, so only a spur would be required to obtain access to the coal field. Other forms of transportation to carry large tonnages of coal to market are not efficient.

The Bear Creek Field also contains coal from the Fort Union formation. Here, nine separate beds, totaling 71 feet of coal were found in a 825 foot stratigraphic interval. The field is limited on the east and north by the line of outcrop, on the south by gradual thinning of beds, and on the southwest by the Beartooth thrust fault. West of Rock Creek, the coals lie in a narrow, steeply dipping zone which again terminates against the Beartooth fault. Small geologic structures interrupt the general southwesterly dip of the bedding. Several thin igneous dikes cut the strata, but they did not interfere with past coal mining.

There is a long history of coal mining in the Rock and Bear Creek areas. Mining began near Red Lodge in 1882. Production increased from 232,000 tons in 1886 to over 1 million tons in 1917. Most of the coal was used by the Northern Pacific Railway, though some went to the Anaconda smelter near Butte. Around 1924 demand for this coal began to diminish due to competition from the open pit mine at Colstrip. In 1932 the mines closed. Over 11 million tons of coal had been produced, entirely by underground, room and pillar mining. Coal was even mined under the town of Red Lodge.

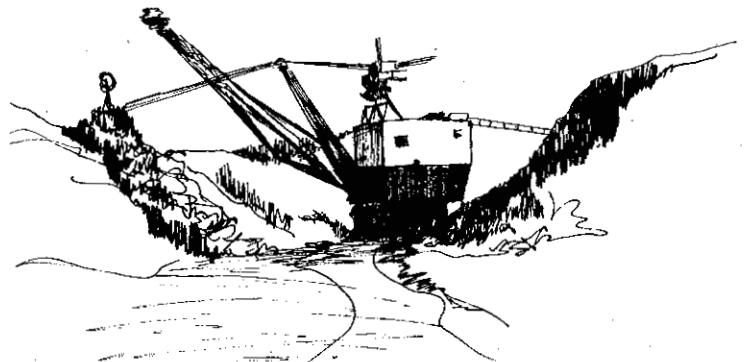
Mining in the Bear Creek area progressed a little behind the Red Lodge Field. Production was very limited until the railroad from Bridger to Bear Creek was completed in 1906. At least eight companies were operating in the area in the early 1900s. Production peaked in the early 1920s, then began to decline in 1926 due to competition from oil and gas. World War II gave impetus for increased production, but after the war production again declined. After abandonment of the Bear Creek-Belfry spur of the railroad in 1953, only small scale mining and trucking of coal to Red Lodge kept the field from closing completely. Eventually even this stopped. Total production of the field was 13 million tons. The Beartooth Coal Co., owned by Portland General Electric, reopened the Brophy underground mine in 1980. That year, over 7,000 tons of coal were produced. Due to labor problems and a soft market, the mine has since shut down.

Though abandoned underground mines in the Bear Creek Field produced coal in the proximity of Federal lands, there has been no recent exploration to determine the thickness, extension, or depth of the several coal beds below Federal lands in this field. Therefore, an estimate of the coal resources may only be very grossly made. Should the thickness of the nine coal beds described above remain consistent (which is unlikely), Federal lands may contain as much as 600 million tons of coal, of which only half would be recoverable. Federal coal ownership forms a nearly solid block 2 to 3 miles inside the outcrop of the various beds.

Westmoreland Resources operates the Absaroka strip mine, along Sarpy Creek in eastern Big Horn County. The company has produced over 30 million tons of state and Crow Tribal owned coal since it opened in 1974. The mine has reported reserves of 600 million tons. The mine has little likelihood of affecting Federally owned coal in the Billings Resource Area, and will not be discussed further.

Only in the Bull Mountain Field may Federal coal be developed by surface mining methods. Surface owners of land overlying Federal coal from both the Mammoth-Rehder and McCleary seams were consulted to determine their preference for or against leasing of their land for surface mining. The results of the consultation are shown in Figures 2.1 and 2.2 and in Table 2.3. Federal coal was found unacceptable for further consideration where the surface owners responded negatively to surface mining.

For the same reason, the unsuitability criteria were only applied in the Bull Mountain Field to coal which passed through the above "screen". The results of that application may be seen in Appendix 2.4 and on the figures and table identified above. The unsuitability criteria will not be applied to underground minable coal until a mine plan application is received which identifies the location of proposed surface facilities.



Industrial Minerals

Bentonite

Bentonite is a general term used to describe a group of clay minerals produced by the alteration of volcanic ash. They have special chemical or physical properties which have hundreds of industrial applications ranging from oil exploration to cattle feed.

Bentonites occur in bedded sedimentary rocks, generally marine shales, deposited during the Cretaceous Period. The thickness of individual beds may range from several inches to more than 6 feet. Valuable bentonite beds have been found in Carbon County. Bentonite of unknown quality can also be found in Yellowstone, Musselshell and Golden Valley Counties.

Two mining companies have located claims for bentonite on the west and southwest flanks of the Pryor Mountains in Carbon County. The American Colloid Company has over 300 placer mining claims, totalling over 6,000 acres of land. These claims are located in the Cloverly, Thermopolis, Mowry and Frontier formations. The company has been prospecting extensively for many years, and has developed some of the claims and trucked the bentonite to its plant near Lovell, Wyoming for processing. The American Colloid Company has produced almost 320,000 tons of bentonite in the last 6 years. The company has been operating under a State Mining and Reclamation Plan since August 1972. Under the Federal surface management regulations (43 CFR 3809), this plan was accepted by BLM in November 1981. American Colloid Company has filed seven patent applications, covering 18 claims and 360 acres. No patents have been issued.

Wyo-Ben Incorporated has located 37 association placer mining claims totalling over 4,000 acres. Wyo-Ben Incorporated is producing bentonite from claims in Wyoming and recently started prospecting its claims in Montana. However, it has not filed a mining plan application with either the Montana Department of State Lands or BLM to date.

The market for bentonites is expected to increase at a rate of approximately 3% per year through 1990 (Ampian, 1982). Wyoming and Montana are the major suppliers of this valuable commodity.

Gypsum

Gypsum also has a multitude of applications, including use as a soil conditioner and in wallboard and plaster construction. It occurs in two horizons in the southern Pryor Mountains. A reported 80 foot thick bed outcrops in the Permian Embar formation, east of Gyp Spring. A 20 to 30 foot thick bed of gypsum occurs at the top of the Triassic Chugwater formation, southwest of Gypsum Creek. There has been no record of production, although old remains of a small kiln can be seen along Gypsum Creek, near the Wyoming state line. Gypsum is also found west of the Pryors in three separate deposits near Bowler, Bluewater and Red Dome. The gypsum lies at the top of the Chugwater formation here, as well.

The only deposit which has been developed is the Daisy-Pillsbury Mine north of Red Dome which opened in 1893. From 1897 to 1904, a small plaster mill was operated nearby. Two placer claims were patented. No mining has ensued since 1920 (Knappen and Moulton, 1930).

There are presently no mining claims located specifically for gypsum, although lode mining claims for uranium minerals may include areas underlain by gypsum deposits near Gypsum Creek.

Prospecting, mining and marketing methods for gypsum are similar to those for bentonite. Because of the distance to market areas, there is probably no demand for Carbon County gypsum. Georgia Pacific can satisfy local demand from its mine at Himes, 10 miles south of Lovell, Wyoming.

The depressed condition of the construction and housing industry has adversely affected the demand for gypsum products. The demand for gypsum products is expected to increase at an annual rate of 2.3% through 1990 (Pressler, 1982). The development potential for Pryor gypsum is considered low.

Vanadium/Uranium

Vanadium/uranium mineralization was discovered in the Pryor Mountains in 1953. The mineralization takes two forms in the Pryor Mountain area. On Red Pryor and East Pryor Mountains, it occurs as mineral coating on limestone breccia in the collapsed caverns of the Madison/Amsden formational contact. Further south, in the hogbacks which overlook Big Coulee, uranium minerals have replaced dinosaur bone remains which are found in the Morrison and Cloverly formations. Concentration of the ores may exceed 0.5% U_3O_8 (uranium oxide) and 1.5% V_2O_5 (vanadium oxide).

Over 1,000 lode mining claims have been located in the area. Many have been maintained since the mid-1950's. Most of the existing road and trail network and the old bulldozed pits are due to the extensive prospecting efforts of 1955-1969. Ore deposits are found through the examination of the surface geology and through the use of a geiger counter or scintillometer. Both detect radiation from the decaying uranium atoms. More recent exploration methods involve the use of a truck-mounted diamond-bit drilling rig.

No ore has been shipped from the area since 1966. From 1955-1966, 7,955 tons of ore were produced, with a gross value of \$326,646 (Frank McGinley, 1971, the Atomic Energy Commission, personal communication).

In the early years, uranium ore shipped from the Pryors was subsidized by the Atomic Energy Commission. The Pryor ores were not economical to develop, but since they were high in calcium carbonate, they were valuable in processing other uranium ores (R. Marchant, 1980, personal communication).

The Pryor Mountain uranium ores can be contrasted with those from the Colorado Plateau (New Mexico, Colorado, Utah) in that the ore material is generally of higher concentration (0.7% vs. 0.1%) but of much lower tonnage (1-5,000 tons vs. 100,000+ tons).

The uranium market is presently very weak. Demand for uranium as fuel for nuclear power plants has decreased along with reduction in power plant construction. High building costs and growing public concern about nuclear power have slowed the industry.

Vanadium is a useful metal for the production of iron and steel alloys, and in the chemical industry. Consumption of the metal should grow at an annual rate of 4% through 1990 (Kuck, 1982). The development potential for these minerals in the Pryors is considered low.

Metalliferous Oil Shales

The Heath formation occupies an extensive area in central and eastern Montana. It serves as a source rock for much of the petroleum produced in central Montana. The Heath outcrops along the flanks of the Snowy Mountains in Golden Valley County.

Black shales in the Heath may have unusually high levels of several important metals: zinc (0.69%), molybdenum (0.09%), selenium (0.012%), vanadium oxide (0.8%) and nickel (0.11%), as well as being "oil shales" with values up to 10 gallons of oil per ton (Desborough et al., 1981).

Two mining companies have located 166 lode mining claims in northern Golden Valley County. The companies, U.S. Energy (66 claims) and Gold Peak Mining (100 claims), staked their claims in April 1981. Most of the claims lie north of the Heath outcrop. Little exploration has occurred to date. Development potential for the deposit is unknown, but suspected to be low since there is no known technology to economically recover such small concentrations of these minerals.

Limestone

Limestone outcrops occur over much of the Pryor and Big Snowy Mountains. It's used locally as railroad ballast and in sugar refining. High purity limestone may have application in the chemical industry as well.

Limestone is mined by Big Horn Calcium Company from two patented claims on the west flank of Red Pryor Mountain. The company also owns 10 (160 acre) placer claims on Custer National Forest lands just east of this quarry. Big Horn Calcium has sufficient reserves to maintain its operation for many years. There does not seem to be a demand for limestone from the Big Snowy Mountains. The deposit may be too far from a use area to be developable at this time.

Sand and Gravel

Sand and gravel are generally unconsolidated sediments deposited along stream channels, abandoned channels about present channels (terrace deposits) or as alluvial fans in mountain foothills. The material is used mostly in road grading and building sites. The value of the sand and gravel depends upon its accessibility, total volume and the percentage of "fines" (clays) found with the sand or gravel.

Most sand and gravel deposits in the resource area are found on private land. They tend to occur along stream channels or terraces where lands have been patented under the homestead laws. However, some terrace deposits remain in Federal ownership. Gravel pits have been developed on public lands along the Yellowstone River near Custer, and in Carbon and Musselshell Counties.

There is a continuous market demand for sand and gravel. The most important deposits are those near population centers or use areas. Transportation of gravel is expensive, and may substantially increase the cost to market it.

Building and Decorative Stone

Building and decorative stone is abundant in the resource area. This material includes lichen-covered rock, flagstone and other colorful rocks. Some important building and decorative properties include shape, thickness, color and its ability to be split.

The resource area generally makes two to four small tonnage sales of decorative stone each year. Most often, the material is lichen-covered "moss" rock.

SOILS/WATERSHED

Runoff from the Billings Resource Area drains into the Yellowstone, Musselshell, Clarks Fork of the Yellowstone, Boulder, Stillwater or Bighorn River (see Table 3.3 for flow data for these rivers). Each major stream is characterized by a dendritic pattern of tributary streams that range from ephemeral (very short-lived) to perennial (present all year). Most of the land uses proposed by this resource management plan (RMP) will be along the Yellowstone mainstem, or in the drainage basins of the Clarks Fork of the Yellowstone or the Musselshell River.

TABLE 3.3: FLOW RECORDS FOR PRINCIPAL RIVERS

	Average Flow (CFS)	Maximum Flow (CFS)	Minimum Flow (CFS)
Musselshell River	229	9,160	.6
Yellowstone River	7,038	69,500	430
Clarks Fork of Yellowstone	1,199	11,800	88
Stillwater River	969	12,000	58
Boulder River	616	9,840	10
Big Horn River	3,970	59,200	275

Source: Water Resources Data for Montana, USGS, 1982

The Yellowstone River, one of the longest free-flowing rivers in the U.S., enters the resource area near Springdale, Montana and flows approximately 150 miles before leaving the resource area at the eastern boundary. The Yellowstone River, from the Yellowstone National Park boundary to Pompey's Pillar, is a stream segment which is subject to Section 5(d) of the Wild and Scenic Rivers Act (PL 90-542). There are 170 square miles of public land in this portion of the Yellowstone River Basin, excluding the Clarks Fork of the Yellowstone.